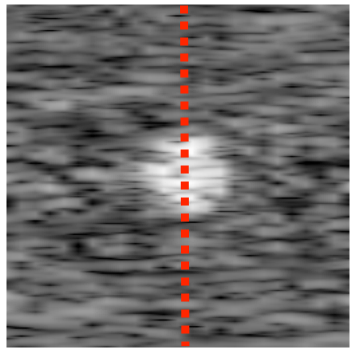
Bayesian Estimation of Sparse Smooth Speckle Shape Models for Motion Tracking in Medical Ultrasound

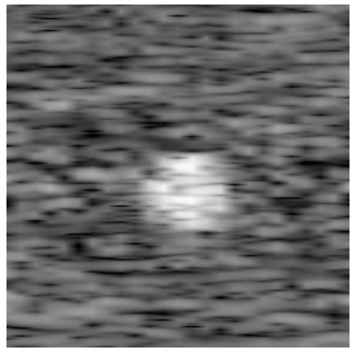
MOTIVATION

In this work, we aim at adapting the speckle tracking echocardiography (STE) technique for measuring strain in structural soft tissue, such as tendons.

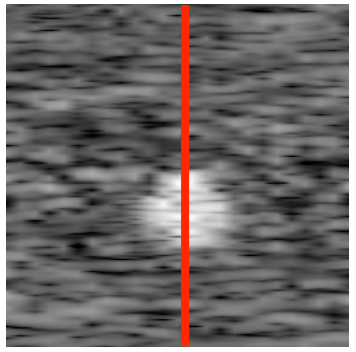
We propose a novel method for directly estimating motion of a sparse selection of speckle shape models instead of using detection and explicit tracking



Frame 1



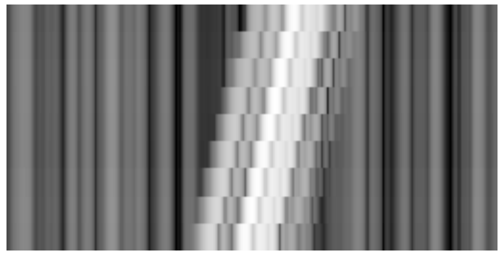
Frame 5



Frame 9
2mm displacement

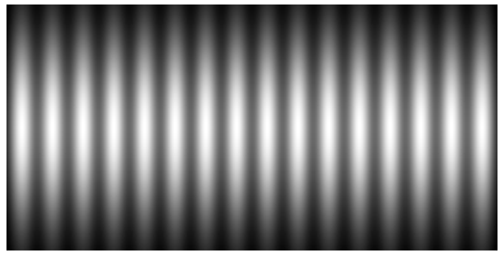
DATA & IMAGE MODELS

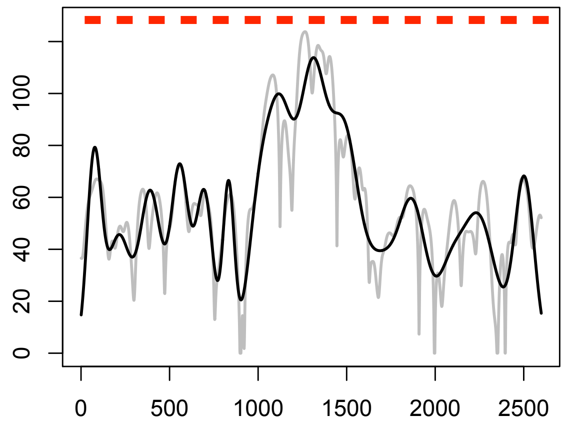
We represent dynamic ultrasound images as a mixture of moving speckle shape models that are approximated by weighted multivariate Gaussians.



STEP 1

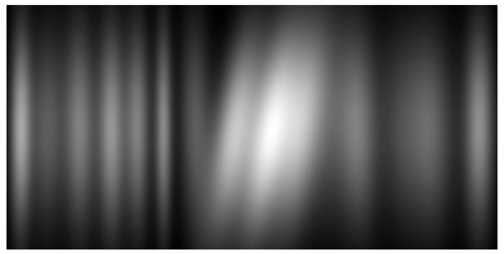
Starting from uniform initialization, maximum likelihood values of kernel parameters are estimated by a conditional expectation-maximization method.

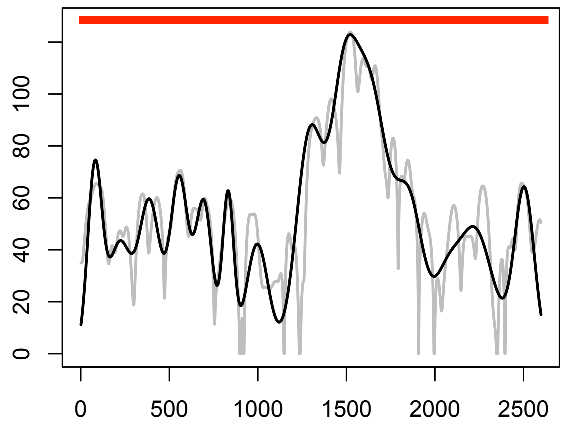




STEP 2

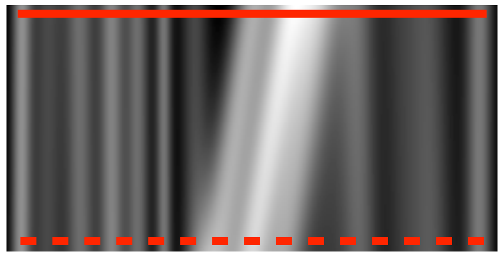
After estimation, the subtle motion of the moving structure on a static background is captured in the sparse model, using only few speckle components.





STEP 3

Normalization of line profiles reconstruct a local linear approximation of the optical flow that is traced by the trajectories of moving speckles.

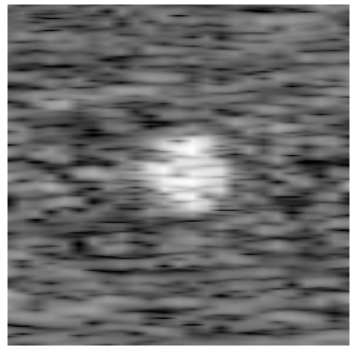


16 mixture components

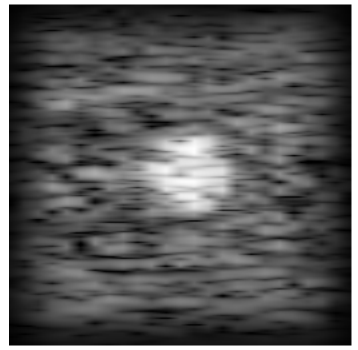
EXPERIMENTS IN 2D

Speckled images can be well represented by mixtures of smooth point scatterers, i.e. modelled by Gaussian kernels.

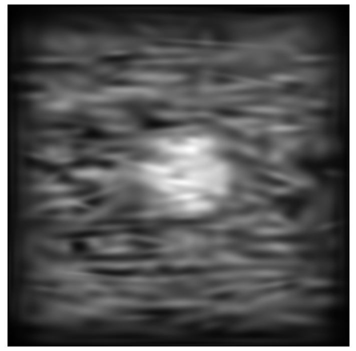
Compensation for truncations (apodization) is needed to alleviate boundary bias artefacts.



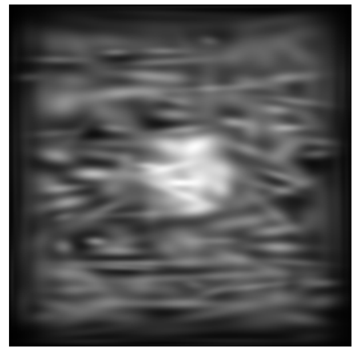
Original data



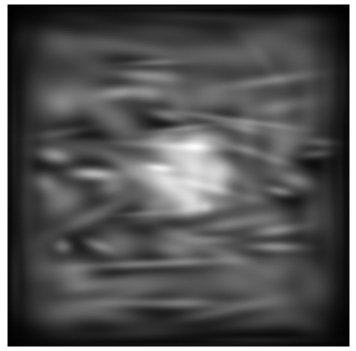
Apodized data



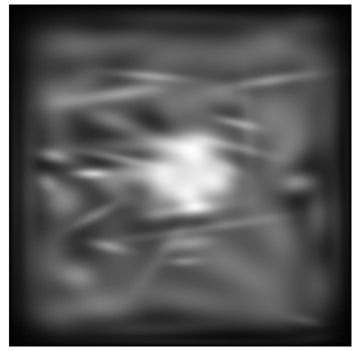
256 elements



128 elements



64 elements



32 elements

Shaun Bundervoet, Colas Schretter, Ann Dooms and Peter Schelkens

iTWIST' 14, Namur, Belgium - August 27-29 2014

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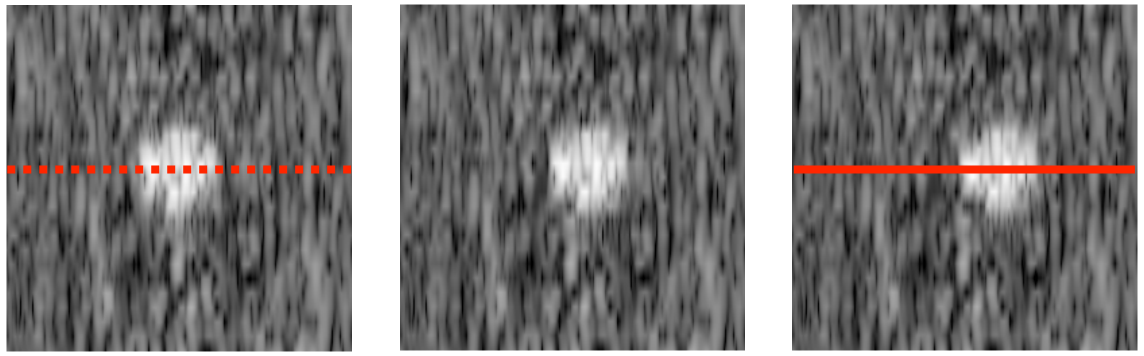

Frame 1 | Frame 5 | Frame 9 2mm displacement

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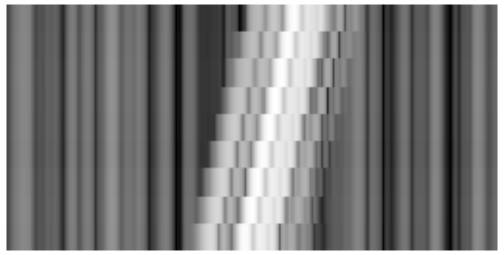

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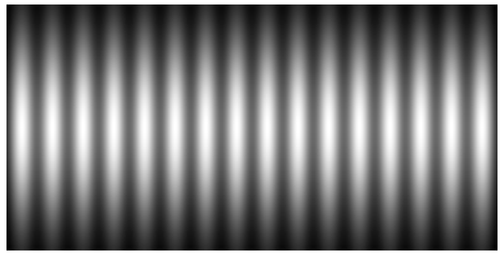

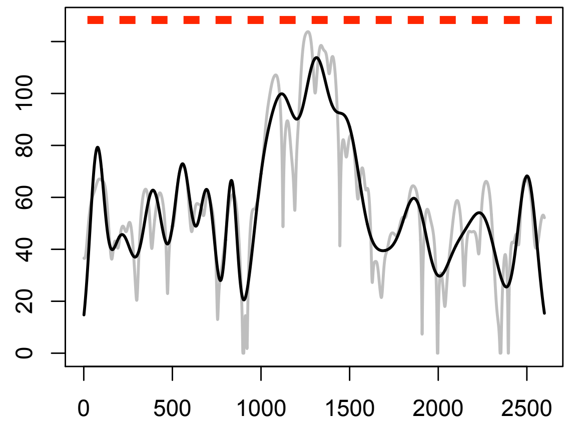

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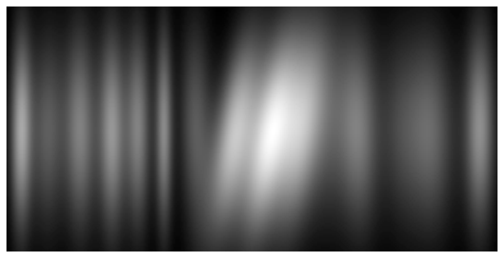

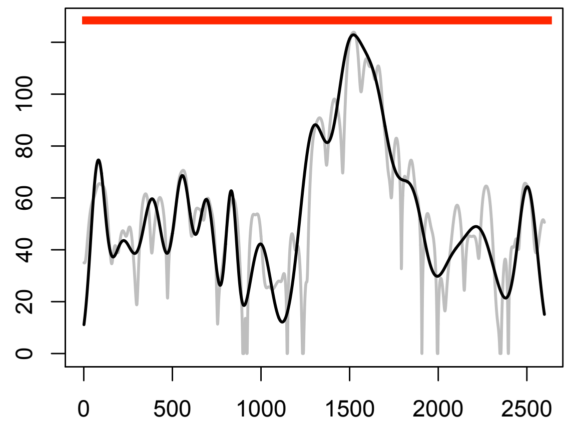

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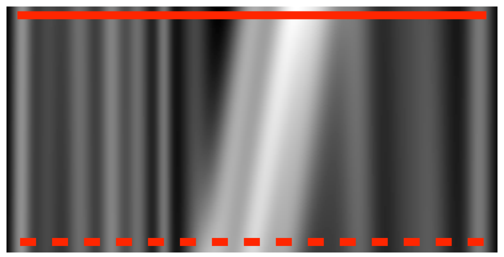
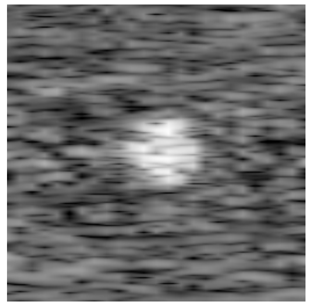


16 mixture components

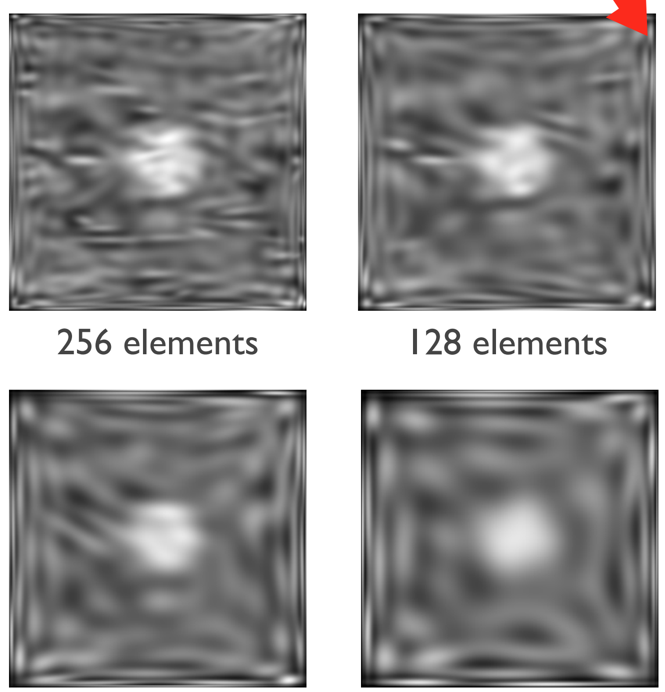
EXPERIMENTS IN 2D

First results show that speckled images can be well represented by mixtures of smooth point scatterers, modelled by Gaussian kernels.

A compensation for data truncation is still needed to alleviate boundary bias artefacts at borders.



Original data



256 elements | 128 elements

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